REMARKS

Claims 1 – 20, 23, and 24 have been examined. Claims 1 – 7, 13 – 15, 18, 20, 23, and 24 stand rejected under 35 U.S.C. §103(a) as unpatentable over U.S. Pat. No. 6,154,582 ("Bazylenko") in view of U.S. Pat. No. 6,080,683[1] ("Faur"), U.S. Pat. No. 6,122,934 ("Narita"), and U.S. Pat. No. 6,204,200 ("Shieh"), and optionally in view of U.S. Pat. No. 6,705,124 ("Zhong"). Each of the remaining claims stands rejected under 35 U.S.C. §103(a) over such cited art further in view of other references identified in the Office Action.

Claims 19, 23, and 24 have been canceled, and Claim 29 has been added. The remaining claims thus include only a single independent claim, i.e. Claim 1, which has been amended to require that the HDP deposition be for a first uppercladding layer that partially fills the gaps, with a second uppercladding layer being deposited thereover with a PECVD process to completely fill the gaps (Application, p. 19, ll. 3 – 16). Amendments have been made to certain dependent claims for consistency with the amendments to Claim 1. Examination of the claims as amended is respectfully requested.

It is believed that the combination of limitations now recited in Claim 1 is neither taught nor suggested by the cited art. Applicants respectfully note their continued disagreement with combining teachings for electronic-device gapfill applications with teachings for optical-device gapfill applications absent a specific teaching to do so. While applicants acknowledge that the prior art teaches gapfill with silicon dioxide in both electronic-device and optical-device contexts, they disagree that one of skill in the art would view specific process parameters identified as suitable for one such art to be relevant to the other. As noted in the response to the previous Office Action, the scales of optical and electronic applications differ by about an order of magnitude. The physical processes involved in gapfill are well known to depend not only on the shape of a gap as defined by its aspect ratio, but on the absolute size of the gap. That is,

[1] There appears to be a typographical error in the Detailed Action.

material is deposited very differently in a gap having a width of about 0.07 μm and a depth of about 0.5 μm as compared with a gap having a width of about 0.7 μm and a depth of about 5.0 μm when the same process is used; this is because the physical mechanism by which the gap is filled is different even though both gaps have an aspect ratio of about 7:1. The gapfill mechanism results form a complex interplay of parameters that affect differently sized structures differently — the gapfill mechanism is affected by quantities that are determined by the process parameters, such as ionic-species density, ion kinetic energy, and the like. Applicants raise this issue of relative size not to argue that a change in size leads to a patentable invention, but to note that the physics that governs gapfill deposition at electronic-device scales and at optical-device scales is different, and that the teachings of the prior art are accordingly limited in application.

For example, the Office Action argues that the difference in feature sizes between Bazylenko and Rossman *increases* the motivation to combine their teachings (Office Action, p. 9). The argument is that Rossman's teaching of increasing the deposition rate would advantageously result in a greater decrease in deposition time at the larger optical-device scales than it would at electronic-device scales. But Rossman teaches specifically that such an increase in deposition rate be coupled with an increase in the simultaneous etching rate provided by an HDP process (Rossman, Col. 2, ll. 54 – 57: "This is accomplished by rapidly increasing the etch rate of the dielectric layer, which allows increasing the deposition rate while maintaining a suitable dep-etch ratio"). Because both the deposition and etch rates are increased, it is not apparent that the overall deposition time is reduced. Rather, the manner in which the plasma interacts with the gap structure is being altered to take advantage of physical processes that improve void-free gapfill in the complex relationship among ionic density, particle kinetic energy, and the like, factors that have been noted as affecting the process differently depending on the size of the structure. It is not apparent that a larger structure, even one of the same shape, would benefit from the same approach because the effect of a high plasma density in a small

structure provides a different physical mechanism for gapfill than it does in a larger structure.[2]

This same reasoning applies to the other references that describe specific processes for electronic-device or for optical-device applications. Because the physics that governs the processes that are described is different, the teachings are limited in scope to the application absent a specific statement that the teachings are more general.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 303-571-4000.

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[2] In this context, Applicants note as follows how the deposition-sputter ratio of Rossman was determined in the previous Office Action. Rossman characterizes the relative contributions of deposition and sputtering arising from the HDP process in terms of a "deposition-etch" ratio defined as:

$$D/E \equiv \frac{D_S}{D_S - D_{(S+B)}},$$

where D_S is the deposition rate with only the RF source applied and $D_{(S+B)}$ is the deposition rate with both the RF source and RF bias applied (Rossman, Col. 12, ll. 42 – 52). Rossman teaches that the D/E ratio be within the range of 2.8:1 to 3.2:1 (*id.*, Col. 12, l. 56). The application characterizes the relative contributions of deposition and sputtering in terms of a "deposition-sputter" ratio defined as:

$$D/S \equiv \frac{(\text{net deposition rate}) + (\text{blanket sputtering rate})}{(\text{blanket sputtering rate})},$$

with the "net deposition rate" referring to the deposition rate measured when sputtering and deposition occur simultaneously and the "blanket sputtering rate" referring to the sputter rate when the recipe is run without deposition gases. The quantities used in each definition are not easily related, but the D/S value may be expressed approximately as

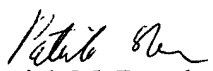
$$D/S \simeq \frac{D_S + D_{(S+B)}}{D_{(S+B)}},$$

with the definition of D/E providing that $D_{(S+B)} = D_S - \frac{D_S}{D/E}$. Substitution of this gives the approximate relationship that

$$D/S \simeq \frac{2-(D/E)^{-1}}{1-(D/E)^{-1}},$$

so that the range of D/E of 2.8 – 3.2 corresponds approximately to a range of D/S of 2.4 – 2.6.

Respectfully submitted,



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